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Approaches to Learning: Is there a Better Way to Prepare Future Pilots?

Abstract

The training of pilots is a critical component in the safety chain. Although the flight deck of the current air carrier or even general aviation aircraft boasts extremely sophisticated equipment, we still tend to prepare flight deck crew-members in much the same way that things have been done for decades. We all probably agree that the development of numerous aeronautical skills is most surely a result of the educational events that a pilot experiences from primary flight training through to advanced instruction. However, little research and study has occurred as to the effectiveness and efficiency of current aviation training methods.

In several research studies previously conducted by Moore, Telfer, and Smith[10] with over 350 air carrier pilots in Australia, other Pacific Rim Countries, and with European airlines, it was found that pilots prefer to learn in a Deep (intrinsic) way as opposed to Surface (rote) and Achieving (results oriented). In a more recent study by Lehrer, Moore, and Telfer[6] the survey instrument previously used with pilots was modified and used with instructors (N = 231) in a major airline, a training academy, a university flight school, and with the general aviation instructor community. The results obtained clearly indicated that the instructors surveyed approached learning from a more Surface orientation and were less likely to employ Deep approaches; the evidence of a misalignment between how pilots prefer to learn and how instructors approach learning was evident. It appears that perhaps the decision making and critical thinking skills that are an integral part of intrinsic teaching approaches and are needed in advanced flight operations are not being taught in the educational process. This presentation will review the data above and outline specific instructional methodologies that enhance a more intrinsic educational approach.

BACKGROUND

Pilots

The identification of the effect of a Deep approach on pilot candidates was found in two initial studies Moore & Telfer[11] and Moore, Telfer, & Smith[10]. In the first , 62 commercial flight and ground training Australian students enrolled in a flying school course were studied and in the later study, 346 airline pilots from five international airlines and 12 individuals from a US aviation institute were the subjects. The survey instrument used for the second study was the Pilot Learning Processes Questionnaire (PLPQ), a 30 item questionnaire with a 6 point Likert scale. The means for each group's preferences ranged from:

1. Deep (4.55 to 4.80) - weighted mean of 4.63,
2. Surface (2.57 to 2.93) - weighted mean of 2.74,
3. Achieving (3.64 to 4.35) - weighted mean of 3.95.

These data suggest that this population of pilots had a propensity for approaching their learning in a meaningful, strategically driven manner. The relatively lower scores for the surface suggest that minimal level interactions with material to be learned were not a major way in which these pilots learned.

Aviation Instructors

In 1997, Moore, Telfer, and Lehrer[8] used a modified PLPQ, the Pilot Instruction Processes Questionnaire (PIPQ) and examined a different but closely related population, the aviation instructor. The sample size for this population was 231. Initial means for the data track the results of Moore, Telfer, & Smith[6] quite closely with respect to the rooftop peaks for both deep and achieving. The construct weighted means were :

*   Deep (4.39).
*   Surface (3.50)

*   Achieving (3.97)

The means from the instructor group for deep and achieving were not within the range of means from the air carrier pilot study mentioned above. Specifically, the pilot means for deep ranged from 4.55 to 4.80 and the instructor mean was somewhat below at 4.39; the pilot means for surface were 2.57 to 2.93 with instructor means quite a bit higher at 3.50 and finally, the means for achieving of the pilots ranged from 3.64 to 4.35 and the instructor mean was solidly in the middle of those scores at 3.97. A series of t tests were performed comparing the data and it was found that the difference in means was significant for Surface and Achieving. For a more extensive review of these data, see Lehrer, Moore, and Telfer[6]. However, it seems apparent that there is a mismatch between how the aviation pilots and the instructors in the respective samples approach learning. Specifically, there needs to be more emphasis placed on Deep techniques and less utilization on Surface techniques of instructional delivery. With this mismatch in mind, it is the intent of this paper to begin to describe the development of some possible ways that aviation instructors may wish to modify their current teaching methods.

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CREATING A NEW PARADIGM FOR
AVIATION TRAINING
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In the following section, three different ways to develop a more intrinsic approach will be examined. One technique, Co-operative Learning, is an instructional strategy while the use of Modeling is an instructional technique, and the employment of the Structure of the Learning Outcome (SOLO) Taxonomy is an evaluative methodology. Each of these techniques is quite different from the current way that instructors usually deliver aviation training.

A Case for Co-operative Learning

As reported by Lehrer, Moore, and Telfer[6], one method of getting instructors and their students or trainees more involved in the learning event is through the use of cooperative learning (CL). In CL, small groups of students work together in a very structured . Specific tenants of such an approach are that students contribute to each other's success and everyone will benefit from the success of the group; there is no room within the group for those that do not contribute to the team's efforts and ultimately the success. Johnson, Johnson, and Holubec[4] identify several types of co-operative learning groups such as

the Formal Cooperative Learning Group, Informal Cooperative Learning Groups, and Cooperative Base Groups. Each group differs in construct and life cycle. The success of such an approach is quite dependent of exactly how group members perceive the group's composition and mission. However, in the truest sense, there are several attributes of CL that form the foundation for the approach. These attributes include:

1. A belief that the group can accomplish goals beyond what an individual might accomplish.
2. Everyone is accountable for the group's progress.
3. As much work is done in face-to-face situations.
4. Social and leadership skills are necessary with all members promoting other's success.
5. A post hoc analysis is always performed concerning group accomplishments and synergism.

In a primary private pilot ground school, several collaborative situations seem obvious beyond just the normal formation of teams for "study groups." In the segment where cross-country planning is undertaken, a team approach with each member contributing a portion of the materials required might be an excellent way to get all involved. Also, rather than doing just one or two exercises, perhaps many routes and destinations could be used with each team member having a different assignment each time. All segments necessary for accurate planning can then experienced by each team member and multiple trips could be investigated. In the corporate or air carrier community, teams could be utilized for initial, transition, or recurrent training periods. Perhaps team members could be "connected" via email prior to class dates and several problems that will be encountered in the training syllabus could receive initial inspection. Granted, there are numerous problems related to schedules, union contracts, duty time, seniority, as well as other items but it would seem possible that getting people to confront and solve these situations is what we are really after in using CL (and what Crew Resource Management is all about?).

Modeling and Thinking Aloud

One of the problems confronting many learners in aviation is that the strategies and ways of successfully completing tasks, be they in the aircraft or on the ground, are little understood or comprehended. In fields other than aviation, there has been extensive use of instructor/teacher modelling and explicit descriptions of thought processes and strategies as the modelling occurs. Based upon the work of the Russian psychologist Vygotsky, the emphasis in such approaches is on the social context of learning with instructors/teachers providing strategic support to the learner. Indeed, in many instances of modelling and thinking aloud, the learner takes turns at being the instructor/teacher, talking out loud about how he or she is going about the task, especially in a strategic way. This is called Reciprocal Teaching (Brown & Palincsar[2]; Moore[9]) where the learner gradually takes on the role of teacher/instructor, with the instructor providing appropriate "scaffolding." Often learners and instructors take turns in strategic activities such as predicting what might occur, questioning each other on the information to be learned, clarifying things that are not fully understood, and summarizing what has been learned. Aviation is an ideal field in which to use such strategies.

An example from a ground school topic in primary flight planning will help illustrate the approach. The focus might be on decision-making related to weather. A scenario is presented and the instructor verbalizes, thinks aloud, about how he or she would go about factoring weather into the overall flight saying things such as "Well, I always set priorities when it comes to weather. My first task is get the most up-to-date information from a number of sources. I then look through the data to see what the important elements are and use my knowledge of the area I am flying to …….In this instance, though, I have not been to the destination before, so I have to change my focus…I can see I have this front moving through here (pointing to faxed maps), and weather reports indicate that there is a strong possibility of restricted visibility so there is a possibility that I might have to divert to this airport.... "

The point here is that the instructor is not telling the student what to do but showing how it is done by explicitly thinking out aloud about what it is being done, inner thoughts are made public. It is much more than instructor "patter." Another scenario would then be presented, and the student would be encouraged to take part in the thinking aloud. So, in this instance, it might be that the student would begin by saying something like, " I see, the first thing I should do is set priorities and what I need to do is to…."and so on. When the student appears unsure, the instructor moves in to support and encourage. Rosenshine and Meister[12] found that in many settings, this form of reciprocal teaching has produced quality learning outcomes.

Linked to modelling and thinking aloud is students' understanding of the ways in which strategies make a difference to learning. If you recognize that the use of a strategy (or set of strategies) is beneficial to learning, then it is likely that you will persevere with future tasks requiring strategic behavior. It is well recognized in the literature that attributing your successes to things within your control (such as strategies and effort) is helpful to learning while attributing your failures to lack of ability and bad luck (things beyond your control) is harmful (Chan & Moore[3]). So, an important part of instruction is to encourage (motivate) students to see that what they do in their learning, and how they go about it, is within their control. If not, then learned helplessness can emerge, a situation where individuals easily "give-up" when things get a bit tough. They ultimately lose faith in their abilities and we do not want this type learning to occur in aviation training situations.

SOLO Taxonomy

The SOLO Taxonomy is a powerful tool that can be used by instructors to assess the effectiveness of the learning activity or task development. First offered by Biggs and Collis[1] SOLO stands for Structure of the Learning Outcome and there are five levels of sophistication:

1. Pre-Structual
2. Uni-Structural
3. Multi-Structural
4. Relational
5. Extended Abstract

Specifically, Jackson[5] stated that Pre-Structural refers to a task or activity that the student does not attack appropriately or understand at all; Uni-Structural is very nominal understanding with perhaps a few tasks or ideas picked up and used; Multi-Structural means that several tasks or ideas are learned and can be treated separately; Relational learning is exemplified by integration of parts and ideas into coherent wholes; and finally, Extended Abstract learning is demonstrated by the student when he or she can re-conceptualize, use abstract combinations of previous topics learned, or turn reflexively on oneself.

The application of SOLO allows the instructor to go much beyond either a pass/fail evaluation or award of a numerical score as the primary evaluation methodology in aviation training. In fact, rather than the student responding in a very rigid and structured manner in evaluation situation, there is the distinct possibility of multiple answers or responses, some which could be quite innovative.

In flight training situations, we will all agree that there are many concrete psychomotor-related ways that airplanes must be flown; reference here is to "according to the book - or company manual." But what about use of SOLO in applications of some higher level emergency situations like the Sioux City, IA accident. It might also be appropriate to instill many more creative approaches to problem solving of flight-related situations in the earliest primary flight training situations, particularly solo cross-country exercises. Do we equip our beginning students to use imagination and/or creativity as appropriate to solve all those things encountered enroute that may have not been experienced in previous dual training situations?

We are very familiar with the traditional way for an instructor to prepare students to pass an exam and that is to covertly "teach to the exam" or overtly even use government aviation exam questions for class evaluations. While such an instructional methodology may promote examination passage, does employing such a technique enhance anything but a Surface Approach? Doing a series of multiple-choice questions is not likely to lead to deep learning. Would it not be better to approach the task of examination passage from a knowledge acquisition orientation and thus successful understanding of concepts rather than "I remember this question and the answer is C" approach. And what about the use of somewhat differing evaluation methods such as portfolios and questioning in other dimensions like essay, true and false, or fill in the blanks? A little more work for the instructor but a more meaningful educational experience for the student.

CONCLUSIONS

In reviewing the apparent lack of congruence in how pilots and instructors approach learning, it is important to realize that a misalignment has major implications for all the key players. Moore, Lehrer, and Telfer[7] found that additional influential entities included the management of the organization. Quite often driven by the need to find the additional funds for additional training are executives who strive to establish a reputation for a well-managed operation; the thought of employing anything other than "this is how we've always done" approach can often fall on deaf ears.

Aviation management needs to develop the same acuity and sensitivity that leads an experienced pilot to automatically adjust out-of-sync engines. Understanding, professional judgement and long experience have provided a blueprint of the feel and sound of balanced power. As soon as a lack of synchronization occurs, there's an automatic reaction to correct it. Aviation organizations need to develop the same homeostatic response to differential values in the training department. Trainees and instructors have to be a collaborative team in order to achieved high quality training. Deep and Achieving are the aim points. Many of the key approaches to adult education (or andragogy) cannot be achieved if the instructor lacks a deep and

achieving approach....or, worse, has only a surface approach.

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